Roadside Safety News

by Rich Peter

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Roadside Safety Technology Branch (916) 227-7257

Roadside Safety Updates Continue

As indicated in our April edition, this newsletter is published by the ESC's Roadside Safety Technology Branch (RSTB) to update key Caltrans staff on the latest developments regarding roadside safety issues. In April we provided a general background on some important aspects of roadside safety. This included:

· The role of the Highway Safety Features New Products Committee in evaluating new proprietary roadside safety hardware for use on state highways,

· FHWA requirements and Caltrans policy regarding compliance of new roadside safety hardware installations with National Cooperative Highway Research Program (NCHRP) Report 350 crash testing criteria,

· Proprietary roadside safety hardware that has recently been approved by Caltrans for use on state highways, and

· A description of the Caltrans crash testing program conducted by the RSTB and a summary of recent crash tests.

This month's newsletter will provide additional information and updates on these subject areas. If you have any questions regarding any past or current newsletter item, please contact Rich Peter at (916) 227-7257 or 8-498-7257.

HSFNPC Acquires New Members

The Highway Safety Features New Products Committee (HSFNPC) has picked up several new members in recent months. A complete list of the current members, including the programs they represent, is provided below. Please contact the representative for your program or area if you have any concerns that you want the committee to be aware of.

Ellis Hirst – Traffic Operations (Chair) (916) 654-2465

Rich Peter – Division of METS, ESC (Vice-Chair) (916) 227-7257

John Jewell – Division of METS, ESC (Secretary) (916) 227-7125

Robert Peterson – D3 (Representative for Districts) (530) 822-7560

Nahed Abdin – Structures (916) 227-8805

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New Members

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Robert Meline – New Technology and Research (916) 227-7031

P.J. Caldwell – Maintenance (916) 684-1822

Joy Pinne – Construction (916) 654-5627

David Cordova – Design and Local Programs (916) 653-0485

Although not a member of the committee, Matthew Schmitz of FHWA usually attends HSFNPC meetings to provide his agency's perspective on roadside safety issues. Mr. Schmitz can be reached at (916) 498-5850.

Caltrans Approves New Products, HSFNPC Recommends Approval of Another

The April newsletter included a description of several new roadside safety products for which approval was pending. The HSFNPC had evaluated these products and recommended that they be approved. All of these products now have formal Caltrans approval for use on the state highway system. These include:

Pole-Safe Couplings (experimental)

QuadTrend (experimental)

QuadGuard Elite (experimental)

Mondo Blockout (experimental)

ET-2000 Plus (operational)

Safe-Stop TMA (operational)

A description of each of these devices was provided in the April newsletter. More information can also be obtained from Ellis Hirst or Rich Peter.

The committee recently completed an evaluation of the QuadGuard TL-2 crash cushion/end treatment and recommended operational approval. The QuadGuard absorbs energy with crushable cartridges mounted in "bays" between steel diaphragms. The standard QuadGuard, which was approved by the Department three years ago on an experimental basis, was designed for high-speed applications. It consists of six bays and has a total length of 6.7 m (22 feet). Crash testing was performed under NCHRP Report 350 TL-3 conditions (100 km/h).

However, there are occasions when the use of a standard TL-3 QuadGuard may be unnecessary or even inappropriate. For example, there may be a need for a crash cushion or end treatment on a low-speed roadway where there is insufficient room for a full-length, standard QuadGuard. In this situation, the QuadGuard TL-2 may be an acceptable solution. This device has only three bays and a total length of 4.0 m (13 feet).

The QuadGuard TL-2 was crash tested under NCHRP Report 350 TL-2 conditions (70 km/h). Consequently, the use of this device should be restricted to locations where there is little or no likelihood of vehicle speeds in excess of 70 km/h. Though Caltrans may use this device on some conventional highways, it will likely have greater application on local streets and roads.

Textured Barrier to Be Evaluated

Aesthetics is growing in importance as an issue in new construction and local agencies and the public are increasing pressure on the Department to make new barriers and bridge rails more attractive. This can be achieved by incorporating colors, textures or patterns into the barrier or rail.

A June 30, 2000 memo from Kim Nystrom, Traffic Operations Program Manager, to the Districts lists allowable aesthetic surface treatments for concrete barrier. These include:

· Coloring added to the concrete mix

· Painting

· Sprayed bituminous emulsion for a "granite look"

· Etching with acid

· Chemical staining

· Light broom finish

· Light sand blasting to roughen the surface

None of these treatments should expose the aggregate in the concrete.

This memo does not allow for the use of any grooves, notches, patterns, or rough textures. Without actual crash testing there is concern that such features may increase the coefficient of friction or snagging potential of the surface of a barrier to the extent that the barrier would no longer be crashworthy. Consequently, the RSTB is developing a research proposal and laying the groundwork for a textured barrier-testing program. The objective of this project will be to determine what types of textures and patterns would be feasible to incorporate into Caltrans facilities.

Because crash testing is expensive and time-consuming, it isn't possible to evaluate every conceivable type of texture and pattern that could be used on state highway barriers. However,

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Textured Barrier

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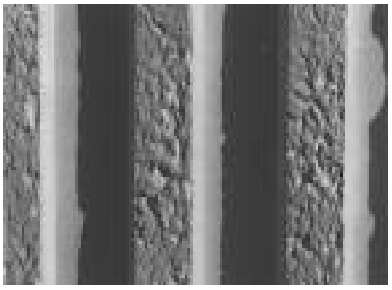
testing a relatively limited number of textures and patterns that cover a broad range of shapes, roughness and angles may be sufficient. If the test designs are carefully chosen, architects and engineers could use the test results to estimate effectively the crashworthiness of barriers with textures different from those tested.

With this objective in mind, the RSTB invited representatives from Bridge Architecture and Landscape Architecture to participate in the selection of textures and patterns to be tested. In addition to RSTB staff, the selection team included Gary Bush and Suzy Namba (HQ Landscape Architecture), Tom Ham (D11 Landscape Architecture), Bill Peach (D3 Landscape Architecture), and Javier Chavez (Bridge Architecture). Robert Meline of New Technology and Research also provided support.

The team identified eight candidate textures and patterns for testing, plus two alternates. Examples include horizontal reveals (grooves), a "mission arch" pattern, vertical and angled flutes, a "dry stack" pattern and cobbles. The team concluded that these candidates include sufficient variability in surface relief, angles and shapes that test results could be applied to most textures and patterns likely to be used by Caltrans on barriers in the future.

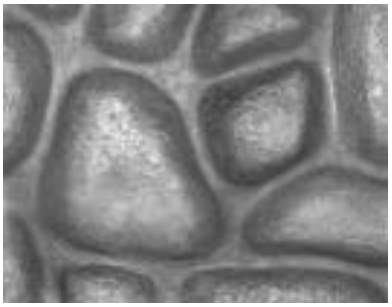
Mission Arch Pattern

To test these patterns, RSTB staff plans to cast concrete panels using molded form liners to create the desired texture or pattern. These panels will then be attached to the face of a Type 60 barrier and impacted by test vehicles at a speed and angle of 100 km/h and 20 degrees, respectively. One pattern or texture will be evaluated per crash test. Evaluation will be based primarily on the manner in which the test vehicle is redirected. A pattern or texture will be judged acceptable if the vehicle doesn't snag, yaw or ride up the barrier face excessively. It is also desirable that the vehicle exit angle is approximately 60% or less than the impact angle.



Vertical Flute Pattern

Another important factor that will be considered in evaluating the patterns and textures is maintenance. If the face of a set of test panels is easily damaged by the vehicle impact, that texture or pattern may be judged as unacceptable, especially if repairs are difficult to make.



Cobble, or "River Rock" Pattern

It is expected that research funding for this study will become available in October 2000. In that event, crash testing is scheduled to begin in February 2001.

"Dry Stack" Pattern

New Transition Design Appears Promising

The FHWA mandates that all guardrail to bridge rail transitions installed after October 1, 2002 on the National Highway System meet NCHRP Report 350 criteria. This has proven to be a very difficult requirement to comply with. Crash testing of alternative transition designs conducted by other researchers has resulted in many failures. The majority of these failures occurred because the transition just upstream from the end of the bridge rail pocketed badly when impacted by the test vehicle, resulting in severe vehicle snagging. Vehicle rollover after transition impact has also been a fairly common mode of failure. Past Caltrans transition testing efforts have resulted in both severe snagging and rollover.

Working with Structures, the RSTB developed a new transition design that incorporates nested thrie beam rail immediately upstream of and attached to the bridge rail. The design also incorporates longer and stronger posts and heavier-gage steel than Caltrans' current standard design, resulting in a much stronger system.

This new design has been crash tested

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New Transition

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twice in the past three months and both *tests* were successful. Each test involved a 2000-kg pickup truck striking the transition at a different location. In both tests the pickups were smoothly redirected with no snagging.

2000-kg Pickup Impacting New Transition Section Design

Only one more crash test remains to be conducted. This test, using an 8000-kg truck, is actually less stringent than the 2000-kg pickup tests, so we anticipate that it will also be successful.

Testing of Removable Barrier Completed

Interstate 5 in the vicinity of Shasta Lake and northward is subject to occasional closures, particularly in the winter, due to traffic accidents, spills, weather and other causes. Because detours in this area are few and lengthy, such closures severely affect traffic operations.

Much of this section of I-5 is divided by continuous Type 60, single-slope barrier. District 2 occasionally has a need to remove short sections (50 m or less) of this median barrier at certain locations so that freeway traffic can temporarily cross the median. This would allow the District to divert traffic more efficiently to appropriate detours. It would also permit temporary two-way traffic flows on one side of the median in the event that the opposite side of the freeway is blocked or closed.

Two years ago, District 2 staff designed a variation of a Type 60 median barrier comprised of 3-m segments joined with pin and loop connections and set in a shallow groove in a concrete foundation. When this barrier was crash tested, it did not perform well. Because the connections were too loose, individual segments rocked back when impacted, exposing a portion of the leading end of the next segment downstream. This resulted in test vehicle snagging.

To resolve this problem, RSTB staff redesigned the barrier. Individual segments were lengthened to 3.7 m to increase their mass. In addition, each segment was fitted with two sets of tight fitting pin and loop connections at each end to minimize independent movement between segments. This new design has been informally named the "Type 60K."

Crash testing involving a 2000-kg pickup truck and an 820-kg sedan was recently completed. Maximum lateral barrier deflection was 760 mm with the truck and approximately 100 mm for the small sedan. No snagging occurred during these tests and the test vehicles were smoothly redirected. Except for some easily replaced bent pins, damage to the barrier was limited to mostly cosmetic scuffing and spalling.

Crash Test of Type 60K Barrier

Once the Type 60K barrier is accepted by FHWA for use on the National Highway System, it may be employed anywhere on the state highway system where such barriers are deemed appropriate. The Type 60K rail may have potential application as a long-term, temporary median barrier. Because of its greater mass and rigidity, it deflects significantly less than unstaked conventional K-rail when impacted and incurs much less damage than the K-rail does, staked or unstaked. More important, the Type 60K barrier redirects test vehicles more smoothly than does the staked K-rail median barrier. Compared with the K-rail, impacting vehicles exhibit far less tendency to climb up the face of the Type 60K. Also, there is almost none of the substantial nose-down pitch displayed by vehicles rebounding off the face of the K-rail.

Errata

The April 2000 newsletter featured an article describing the Caltrans process for the assessment and approval of new roadside safety products. There was a typographical error in a sentence appearing at the top of column 3, page 2 in some copies of the newsletter. This sentence read "The METS Roadside Safety Features Branch performs the crash testing and presents the results to the full committee." This sentence should have read "The METS Roadside Safety Features Branch performs *an analysis of* the crash testing and presents the results to the full committee." The RSFB does not crash test proprietary products, but requires that the manufacturer or vendor of these products provide the necessary crash testing data.